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A. D. MELVIN, CHIEF OF BUREAU.

METHODS AND RESULTS OF PARAFFINING CHEESE.

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BY

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LETTER OF TRANSMITTAL.

United States Department of Agriculture,
Bureau of Animal Industry,
Washington, D. C., August 11, 1911.

Sir: I have the honor to transmit herewith, and to recommend for publication in the circular series of this bureau, a manuscript entitled "Methods and Results of Paraffining Cheese," by Mr. C. F. Doane, assistant dairyman in the Dairy Division.

The paraffining of cheese has been found to be of considerable value in preventing loss in weight and the growth of mold. In this paper the author reports experiments indicating the methods and conditions under which the best results have been obtained. The conclusions are summarized at the end of the paper.

Earlier work of the Dairy Division relating to this subject has been reported in Bulletins 49, 83, and 85 of this bureau.

Respectfully,

A. D. Melvin,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

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METHODS AND RESULTS OF PARAFFINING CHEESE.

The practice of paraffining cheese is of comparatively recent date. We have no record of who was the first to introduce it, but it was about 10 years ago that it was brought to the attention of cheese handlers, and about 6 years since it became a general practice to use a coating of paraffin to protect cheese. At the present time nearly all cheese of the Cheddar type made in the United States is paraffined at some stage before it reaches the consumer.

THE OBJECT OF PARAFFINING.

Cheese was first paraffined on a large scale in order to improve its appearance. A green mold appears quickly on cheese that is not constantly handled and treated in some manner to prevent its growth. When cheese has been stored for any length of time without the necessary attention its surface presents a very uninviting appearance. It was customary for the large dealers to scrape the surface before it was shipped to the retail dealer or placed on the counter to sell to the consumer. This required much labor and resulted in a considerable loss of the cheese, as a very appreciable amount was scraped off while removing the mold.[1]

Soon after the practice of paraffining became general it was found to have an even more important economic effect than improving the appearance. Formerly there had been considerable losses in stored cheese due to the evaporation of the contained moisture, and it has since been proved that this evaporation did not in any way add to the value of the product by improving its quality. It was found that the protecting coat of paraffin to a great extent prevented this evaporation and the consequent loss. The actual saving by paraffining is about 3 per cent of the gross amount of cheese made, which would amount to a very large sum of money when all of the cheese of the Cheddar type made in the United States is considered.

[1] Exporters report a prejudice against paraffining still existing among a large proportion of English dealers and consumers, who want the cheese with the mold on, although there can be no question of the improved appearance of the product as a result of paraffining.

DEVELOPMENT OF THE PROCESS.

Cheese was first paraffined on an extensive scale by dipping it into paraffin that had been melted and heated over a direct flame or in a bath of hot water. No material change from this original process has yet been made. There has been a natural evolution in styles of vats and in the apparatus for handling the cheese rapidly, but the apparatus is necessarily very simple even in the most modern plants. Very little attention has been paid to the effects of different temperatures of the paraffin at the time the cheese is dipped, and no uniform temperature has been advocated or used. The paraffin is heated usually by a steam coil in the bottom of the vat. This is a decided improvement over the use of the hot-water vat or the direct flame, though the hot-water bath is still used extensively.

The direct-flame method of heating has been discontinued as being too dangerous. There is naturally a tendency toward a very wide difference in the temperatures where a steam coil is used and also with the hot-water bath.

It was customary at first to have the cheese from two weeks to a month old at the time of paraffining, and the cheese that was not stored by the dealers but went directly to the retail markets was not paraffined. At the present time practically all cheese is paraffined, and as the dealers receive cheese at a much earlier period after it is made than was formerly the case, paraffining is done at a correspondingly earlier period. The work is usually done when the cheese is received at the warehouses of the dealers; economic reasons relating to handling and losses in weight have had a natural tendency toward bringing this about. Most cheese is now about one week old when it is paraffined, and practically all cheese is treated by the time it is two weeks old, though in a few cases cheese a month old is paraffined.

Most of the paraffining is done by the large dealers who buy direct from the factories, though at the present time a number of the more advanced factorymen have outfits of their own. The dealers appear to make serious objections to the factory operators doing their own paraffining, although no difference in price is made.

Slightly different grades of paraffin are used at different seasons. That commonly used in the summer months has a melting point of about 125° F., and for winter use a paraffin with a lower melting point is used. The cost is about 6 cents a pound.

CONSTRUCTION OF TANKS FOR PARAFFINING.

Tanks are made from a heavy grade of galvanized iron, supported with angle iron in the larger tanks. The tanks used by the large handlers of cheese are made wide enough to take in the largest sized cheeses edgewise; that is, about 18 inches, and deep enough totally to

submerge any cheese. They are usually deep enough to submerge the cheese after a large proportion of the paraffin has been used. Thirty inches is a good depth. The length can be made to suit the operator. They are usually about 6 feet long. A factory tank need not be so large; a good size for such would be 24 inches long, 16 inches wide, and 22 inches deep.

The tanks are heated by steam coils or in a hot-water bath, the steam being much more satisfactory, as the hot-water bath will not heat the paraffin high enough for the best work. As much heating surface as practicable should be provided because the paraffin cools very rapidly during the process of dipping. A coating of asbestos about the tank is very satisfactory to help retain the heat of the paraffin. The rack which holds the cheese should be counterbalanced by sufficient weight to hold the cheese out of the paraffin when the rack is loaded or full. Most racks are made with iron rods for the cheese to rest on. Wood in place of the iron would be more satisfactory, as the iron becomes very hot and melts the cheese where it comes in contact with it.

PREVIOUS EXPERIMENTAL WORK.

There have been a number of experiments in which the effect of paraffining on the loss in weight and the quality of the cheese were considered. It was uniformly found that the process had no detrimental effect on the quality, and that while the losses in weight of paraffined cheese during storage varied, they were under all conditions very slight, and considerably less than was the case with cheese not paraffined.

In some previous unpublished work done by the writer it was found impracticable to paraffin cheese which has been held for some time in cold storage. Such cheese when paraffined is very likely to show a heavy growth of mold under the paraffin coat, this being due to the fact that the cold surface of the cheese prevents a thorough sterilization when the paraffin is applied. This, however, has been overcome by allowing the cheese to remain in the paraffin for a longer period of time.

The numerous problems involved in the use of paraffin at different temperatures and with cheese of various ages have never been satisfactorily worked out. Many conflicting opinions have been held by different handlers of cheese as to the results to be expected from variations in age and temperature, and as previous experience with experimental cheese has seemed to indicate that many of the prevailing opinions were partly or wholly erroneous it was evident that further work was necessary to put the process on a basis of exact knowledge.

PLAN OF PRESENT WORK.

Experimental work in paraffining cheese is necessarily rather simple, as not many variations are possible in the process and the results are easily noted and comparatively conclusive. The faults common in paraffined cheese are cracking or peeling of the paraffin, undeveloped surface color, surface mold, and surface decay or rind rot. These faults, it would seem, must be due to one or more of three possible causes: (1) The age of the cheese when paraffined; (2) the temperature of the paraffin, and the length of time that it is applied; and (3) the way the cheese is handled after it has been immersed.

Handlers of cheese have contended that a high moisture content would cause serious faults, but the writer has seen considerable cheese with a high moisture content that was beyond criticism after paraffining and storing for a number of months.

In addition to determining the effect of the factors mentioned above, it seemed desirable to note the losses in weight after paraffining of cheese dipped at different ages, also the amount of paraffin which adhered to the surface of the cheese when applied at different temperatures and for varying periods of time.

The work described in the following pages was conducted at a factory near Plymouth, Wis. The factory has a very satisfactory paraffin tank heated with a steam coil, where all practical temperatures could be obtained, and its proximity to a good cold-storage warehouse in Plymouth made it especially convenient for this work.

Cheese from the regular daily make was used, vats of good curds being selected. Moisture determinations were made on each lot. The "daisy" size of cheese was used, as it is a representative type.

SHRINKAGE IN CHEESE AS AFFECTED BY THE AGE AT WHICH PARAFFINED.

As it is known that cheese of any age above one week can be profitably paraffined, the problem is reduced to a question of the earliest age when the work can be satisfactorily done. For the experiments given in this report 7 lots of cheese were made, each lot consisting of 9 cheeses. Of these, 3 were paraffined as they came from the press and before the surface moisture had had time to dry off; 3 were paraffined three days after coming from the press, and the remaining 3 seven days after coming from the press. The data of 4 of these lots, including all temperatures used, are given in the table below; the remaining lots were not weighed. The cheese was weighed immediately after paraffining and again at the time of scoring in February, after being in storage about 5 months. The cheese was stored at 35° F. The weights and losses from shrinkage were as follows:

TABLE 1.—*Shrinkage of cheese after paraffining at different periods.*

Lot No.	Cheese No.	Age when paraffined.	Weight when paraffined.	Weight when scored.	Shrinkage.
			Pounds.	*Pounds.*	*Pound.*
	1	From press	21.69	21.31	0.38
	2	.....do	21.84	21.34	.50
	3	.....do	21.66	21.19	.47
	4	3 days	21.25	21.13	.12
1	5	.....do	21.41	21.31	.10
	6	.....do	21.47	21.38	.09
	7	7 days	21.19	21.06	.13
	8	.....do	21.00	20.88	.12
	9	.....do	21.09	20.94	.15
	1	From press	21.75	21.06	.69
	2	.....do	21.75	21.19	.56
	3	.....do	21.47	20.94	.53
	4	3 days	21.38	21.22	.16
2	5	.....do	21.19	21.00	.19
	6	.....do	21.50	21.38	.12
	7	7 days	20.97	21.00	(1)
	8	.....do	21.06	21.00	.06
	9	.....do	21.13	21.06	.07
	1	From press	21.94	21.44	.50
	2	.....do	21.56	21.16	.40
	3	.....do	21.81	21.31	.50
	4	3 days	21.44	21.28	.16
3	5	.....do	21.38	21.28	.10
	6	.....do	21.53	21.28	.25
	7	7 days	20.88	20.81	.07
	8	.....do	21.00	20.94	.06
	9	.....do	21.06	20.97	.09
	1	From press	22.06	21.56	.50
	2	.....do	22.13	21.75	.38
	3	.....do	22.19	21.63	.56
	4	3 days	21.88	21.63	.25
4	5	.....do	21.59	21.31	.28
	6	.....do	21.38	21.19	.19
	7	7 days	21.44	21.31	.13
	8	.....do	21.00	20.94	.06
	9	.....do	20.88	20.75	.13

[1] An apparent gain in weight, which might be due to surface moisture.

Summary of foregoing table.

Age when paraffined.	Average weight when paraffined.	Average weight when scored.	Average shrinkage.
	Pounds.	*Pounds.*	*Pound.*
From press	21.81	21.31	0.50
Three days old	21.44	21.28	.16
Seven days old	21.06	20.97	.09

It is seen from the above that the average shrinkage in the cheeses paraffined from the press was 0.50 of a pound, or 8 ounces, per cheese; those paraffined when three days old shrank on an average 0.16 of a pound, or $2\frac{1}{2}$ ounces; and those paraffined at seven days lost 0.09 of a pound each, or $1\frac{1}{2}$ ounces.

As all the curd was weighed into the hoops to insure fairly uniform individual weights in each lot in the finished product, and the difference in the shrinkage of cheese paraffined direct from the press and that paraffined at three days of age is about the same as the difference in weight at the time of paraffining, it is fairly safe to assume that

the total press weights of all the cheese paraffined at once and of that paraffined at three days of age was approximately the same. Therefore, practically nothing was saved in the matter of shrinkage by paraffining straight from the press, as compared with paraffining at three days of age, while it is shown later on that the latter insures a better quality of product.

There are some interesting comparisons between the lots paraffined at different ages if the shrinkage before and after paraffining is considered. While there is a comparatively heavy loss in weight every day that a cheese is allowed to go unparaffined, very little seems to be gained by paraffining the cheese directly from the press, as compared with paraffining at three days of age. On the other hand, there is a very noticeable difference in the final weights and the loss sustained between cheese paraffined at three days of age and at seven days of age.

When it is considered that the shrinkage of paraffined cheese in storage apparently has very little, if any, relation to the water content of the cheese, it is difficult to explain why cheese paraffined from the press should shrink so much more in storage than cheese paraffined at three days old.

QUALITY OF THE PARAFFIN COAT AS AFFECTED BY TIME OF DIPPING AND TEMPERATURE OF PARAFFIN.

After about five months in storage the eight lots of cheese were examined and the quality of the paraffin coat graded on the basis of 100 for a perfect coating. As this was the first time scoring of this kind had been done, there was some question as to the proper allowance to make for different faults, and it is possible that in some cases where the faults were the most serious sufficient reductions were not made. However, questions of this kind always arise in connection with attempts to arrange relative quality, or lack of quality, on a numerical basis. The scoring was done by two competent judges. The detailed results, with the average scoring, are given in the following table:

TABLE 2.—*Quality of paraffin coating.*

Lot No.	Cheese No.	Temperature of paraffin.	Time dipped.	Age of cheese.	Judge.	Score.	Remarks.
		°F.	Seconds.				
1..	1	190	1	Fresh..	Mc.....	85	Mold, heavy paraffin.
					M.....	85	Rough, some mold under bandage, bad where bandage laps.
	2	190	10	...do....	Mc.....	90	Poor appearance.
					M.....	88	Rough, some mold, cracked in places.
	3	190	30	...do....	Mc.....	91	Slight mold.
					M.....	93	Cracked slightly, a little mold in spots.
	4	190	1	3 days..	Mc.....	94	
					M.....	96½	Trifle rough, some blotches, a little mold.

TABLE 2.—*Quality of paraffin coating*—Continued.

Lot No.	Cheese No.	Temperature of paraffin.	Time dipped.	Age of cheese.	Judge.	Score.	Remarks.
		°F.	*Seconds.*				
	5	190	10	3 days..	Mc.....	95	
					M.....	98	Trifle rough.
	6	190	30	...do....	Mc.....	92	Shows little rot under paraffin.
					M.....	94	Some moisture under bandage where it laps, edge will give rind rot.
1..	7	190	1	7 days..	Mc.....	93	Not evenly coated.
					M.....	97½	Cracked slightly, trifle rough.
	8	190	10	...do....	Mc.....	92	Shows trifle rot under paraffin.
					M.....	90	Some moisture under bandage, will cause rind rot.
	9	190	30	...do....	Mc.....	96	
					M.....	98	Do.
	1	240	1	Fresh..	Mc.....	92	Moldy, poor appearance.
					M.....	95½	Trifle rough, some moldy spots.
	2	240	5	...do....	Mc.....	92	Little moldy, uneven.
					M.....	96	Little mold on paraffin, some small white dry spots.
	3	240	10	...do....	Mc.....	90	Moldy, uneven, poor appearance.
					M.....	95	Some dry blotches, trifle rough.
	4	240	1	3 days..	Mc.....	97	Good job.
					M.....	97½	
2..	5	240	5	...do....	Mc.....	98	Do.
					M.....	97	Trifle rough.
	6	240	10	...do....	Mc.....	98	Good job.
					M.....	97	Trifle rough.
	7	240	1	7 days..	Mc.....	96	Very good.
					M.....	97	Trifle rough.
	8	240	5	...do....	Mc.....	96½	Trifle uneven.
					M.....	97	Trifle rough.
	9	240	10	...do....	Mc.....	95	Trifle heavy and uneven.
					M.....	97	Trifle rough.
	1	220	1	Fresh..	Mc.....	90	Moldy and cracked appearance.
					M.....	88	
	2	220	5	...do....	Mc.....	90	Do.
					M.....	88	Dry blisters, moldy, paraffin cracked.
	3	220	10	...do....	Mc.....	90	Moldy and cracked appearance.
					M.....	88	
	4	220	1	3 days..	Mc.....	95	Trifle uneven and heavy.
					M.....	96½	Paraffin thick.
3..	5	220	5	...do....	Mc.....	95	Slight mold.
					M.....	97	Trifle rough, few small cracks.
	6	220	10	...do....	Mc.....	97	Good.
					M.....	97	Paraffin slightly cracked.
	7	220	1	7 days..	Mc.....	95	
					M.....	97	Trifle rough and white.
	8	220	5	...do....	Mc.....	97	Good.
					M.....	97	Trifle rough and white.
	9	220	10	...do....	Mc.....	97½	Good.
					M.....	94½	Trifle rough, some moisture under paraffin on face.
	1	275	1	Fresh..	Mc.....	90	Very moldy, poor appearance.
					M.....	92	Moldy, rough and blotches.
	2	275	5	...do....	Mc.....	90	Very moldy, poor appearance.
					M.....	92	White dry blotches, mold, and rough.
	3	275	10	...do....	Mc.....	90	Very moldy, poor appearance.
					M.....	92	Moldy, rough, blotches.
	4	275	1	3 days..	Mc.....	98	Good job.
					M.....	96½	Trifle rough and blotched.
4..	5	275	5	...do....	Mc.....	95	Slight mold.
					M.....	95½	Trifle rough.
	6	275	10	...do....	Mc.....	96½	Slight mold.
					M.....	95½	Some mold spots, trifle rough.
	7	275	1	7 days..	Mc.....	97	Good.
					M.....	96½	Trifle rough, very slightly blotched.
	8	275	5	...do....	Mc.....	95	Trifle heavy and uneven.
					M.....	96½	Rough.
	9	275	10	...do....	Mc.....	97	Good.
					M.....	96½	Trifle rough, very slightly blotched.
	1	190	1	Fresh..	Mc.....	91	Trifle moldy and cracked appearance.
					M.....	93½	Cracked a trifle and some mold.
	2	190	10	...do....	Mc.....	85	Mold and cracked appearance.
5..					M.....	90	Cracked, rough, some mold.
	3	190	30	...do....	Mc.....	89	Moldy and cracked appearance.
					M.....	94	Moldy, some blotches, cracked.
	4	190	1	3 days..	Mc.....	86	Mold, cracked appearance.
					M.....	85	Some mold, moist under paraffin.

TABLE 2.—*Quality of paraffin coating*—Continued.

Lot No.	Cheese No.	Temperature of paraffin.	Time dipped.	Age of cheese.	Judge.	Score.	Remarks.
		°F.	*Seconds.*				
	5	190	10	3 days..	Mc.....	82	Uneven and heavy coated.
					M.....	80	Much moisture under paraffin.
	6	190	30	...do....	Mc.....	86	Uneven and heavy coated.
					M.....	89	A trifle better than lot No. 5, cheese No. 5, but same trouble.
5..	7	190	1	7 days..	Mc.....	87	Heavy coated and uneven.
					M.....	90	Some moisture under paraffin, rough.
	8	190	10	...do....	Mc.....	86	Heavy coated, dull appearance.
					M.....	85	Moist under paraffin.
	9	190	30	...do....	Mc.....	85	Uneven, shows rind rot.
					M.....	88	Rough, moist under paraffin, coarse rot all over surface.
	1	240	1	Fresh..	Mc.....	90	Moldy, cracked, poor appearance.
					M.....	87	Rough, moist under paraffin on face.
	2	240	5	...do....	Mc.....	90	Moldy, cracked, poor appearance.
					M.....	87	Same as lot No. 6, cheese No. 1.
	3	240	10	...do....	Mc.....	90	Do.
					M.....	87	Badly cracked and moldy.
	4	240	1	3 days..	Mc.....	95	Uneven, slight rot on end.
					M.....	94½	Rough, some moisture under paraffin on face.
6..	5	240	5	...do....	Mc.....	97½	Good.
					M.....	96	Few blotches, trifle rough.
	6	240	10	...do....	Mc.....	90	Uneven, heavy, slight rind rot.
					M.....	94	Some moisture under paraffin; will rind rot.
	7	240	1	7 days..	Mc.....	95	Uneven, slight rot on one end.
					M.....	93	Rough, moist on face under paraffin.
	8	240	5	...do....	Mc.....	95	Same as lot No. 6, cheese No. 1.
					M.....	94½	Rough, moist under paraffin.
	9	240	10	...do....	Mc.....	95	Uneven, slight rot on one end.
					M.....	94½	Rough, moist under paraffin on one face.
	1	220	1	Fresh..	Mc.....	94	Slight mold.
					M.....	94	Cracked paraffin, moldy.
	2	220	5	...do....	Mc.....	95	Uneven and heavy.
					M.....	97	Some dry blotches.
	3	220	10	...do....	Mc.....	93	Slight mold.
					M.....	92	Paraffin cracked and moldy.
	4	220	1	3 days..	Mc.....	98	
					M.....	97½	Not moldy.
7..	5	220	5	...do....	Mc.....	98	Slight mold.
					M.....	97½	
	6	220	10	...do....	Mc.....	94	Do.
					M.....	94	Moldy and blotched.
	7	220	1	7 days..	Mc.....	94	Uneven and heavy.
					M.....	95½	Some moisture under paraffin.
	8	220	5	...do....	Mc.....	97½	
					M.....	97½	Trifle uneven, no mold.
	9	220	10	...do....	Mc.....	97½	
					M.....	97	Trifle white.
	1	240	1	3 days..	Mc.....	97	Good.
					M.....	97	Trifle rough.
8..	2	240	1	...do....	Mc.....	95	Slight mold, trifle uneven.
					M.....	96½	Trifle rough.
	3	240	1	...do....	Mc.....	95	Slight mold, trifle uneven.
					M.....	94½	Moldy, dry blisters.

Average scores:

From press	90.7
Three days of age	94.3
Seven days of age	94.6

RESULTS OF PARAFFINING FROM THE PRESS.

At the time of scoring it was noticed that practically every cheese paraffined at the time it came from the press was covered with blue mold, which was growing on the surface of the paraffin and not between the paraffin coat and the surface of the cheese. In some cases there was not sufficient mold to materially affect the sale value

or to make it necessary to clean the surface, but the greater number of the cheeses were badly covered. The writer has no definite reason to offer as to why mold should grow on the surface of a cheese paraffined when taken from the press when it does not grow on a cheese paraffined at 3 days of age or older. It is possible, however, that some whey found its way through the paraffin covering and furnished conditions of food and moisture necessary for the growth of the mold. Appreciable quantities of moisture escaped from the paraffined cheese, as has been noted in the discussion following Table 1.

Cheese paraffined from the press does not get the color of the rind as quickly as when the color is allowed to develop before paraffining. It requires about a month for the color to fully develop, and if the dipping is done in the factory the dealer is likely to be suspicious that the cheese has too much acid. The slowness with which the color develops in the cheese paraffined fresh from the press would be a serious disadvantage if the cheese were intended to go on the market at once, but it would be no disadvantage where the cheese is to remain in storage for some time. However, the growth of mold on the surface of cheese treated at this stage is of itself sufficient to condemn the practice of paraffining from the press.

RESULTS OF PARAFFINING AT THREE DAYS.

The results for the cheese paraffined at three days from the press are summarized in the following table:

TABLE 3.—*Average scores of cheese paraffined three days from press.*

Temperature of paraffin.	Scored by Mc.				Scored by M.			
	Time dipped (seconds).				Time dipped (seconds).			
	1	5	10	30	1	5	10	30
°F.								
190	90	.....	88½	89	90¾	.....	89	91½
220	96½	95	95½	.....	97	97	95½	.....
240	96	97¾	94	.....	96	96½	95½	.....
275	98	95	96½	.....	96½	95½	.....	.....

The table shows uniformly good results at 220° F. and higher temperatures. At 190° F. the results were usually unsatisfactory. It was observed at the time of paraffining that with cheese immersed in paraffin at 190° F. for one second the paraffin did not adhere to the surface and could be peeled off. Therefore when such cheese was roughly handled the paraffin would be likely to crack and scale off. A cheese dropped on the floor to test this point showed bad cracks,

due to the heavy coating of paraffin and to the fact that it had not cemented to the surface of the cheese. When the cheese was dipped for 10 seconds, the surface of the cheese became sufficiently heated to allow the paraffin to penetrate it while the excess paraffin dripped off before solidifying.

RESULTS OF PARAFFINING AT SEVEN DAYS.

The judges gave the cheese paraffined at seven days practically the same average score as the cheese paraffined at three days of age. In this connection, however, attention should be called to a defect or fault in the paraffining which was noted very much oftener in the cheese paraffined at seven days than in the cheese paraffined at three days. This particular fault goes by the term "rind rot" and is characterized as moisture under the paraffin. It is a genuine decay of the surface of the cheese and shows white blotches of varying size, sometimes small and sometimes covering a large part of the cheese. These whitened areas do not, as a rule, detract materially from the appearance of the cheese as does mold or cracks in the paraffin, but the rind rot does injure the cheese itself, which is not the case with mold or cracked paraffin. Because of this tendency to rind rot in the cheese paraffined at seven days of age paraffining at three days of age is much preferable. The writer has observed some cheese paraffined at a greater age than seven days and the tendency to rind rot was more pronounced than in the cheese paraffined at an earlier stage.

In this connection it seems worthy of note that buyers and handlers of cheese in general have maintained that rind rot was due to the cheese having too much moisture or to paraffining the cheese before the surface had dried after removing from the press. The results would indicate that rind rot is due to an entirely different condition, not related directly at least to the moisture of the cheese. A little misunderstanding might result from the fact that the terms "surface moisture" and "rind rot" are used interchangeably in Table 2. This use of the term "surface moisture" is a mistake, and the term is commonly used because of an apparent rather than a real condition.

INFLUENCE OF LENGTH OF IMMERSION.

There was no appreciable advantage in the use of any particular length of time for the immersion except as noted above for the lower temperature. At 220° F. and upward good results were secured at 1, 5, and 10 seconds.

EFFECT OF KEEPING CHEESE IN WARM ROOM AFTER PARAFFINING.

Many factory men paraffin cheese to prevent shrinkage and then allow the cheese to stand in the factory curing room several days before placing it in cold storage. Lot 8 in Table 2 was included in the experiments to determine the effect of this practice on the appearance of the cheese. In this lot were three cheeses paraffined at three days from the press; No. 1 went to storage at once, No. 2 after three days, and No. 3 after one week. The curing room was warm, and the cheese commenced to look white three days after paraffining; the one that remained in the curing room one week was markedly so. This white appearance was also noticeable at the time of scoring, but as it was evenly distributed and not in blotches the judges did not see fit to make a deduction for this defect. It is probable, however, that most of the objections on the part of the dealers to paraffining in factories is due to this change in color caused by holding the cheese too long after paraffining before shipping to storage.

AMOUNT OF PARAFFIN USED AT DIFFERENT TEMPERATURES.

To determine the amount of paraffin retained by the cheese when immersed at different temperatures for different periods of time, tests were made at 190°, 249°, and 275° F. At the lower temperature, periods of 1, 5, and 30 seconds were used; at 240° and 275° F., periods of 1 and 10 seconds. Eight cheeses of the "daisy" style were used in each test. The results are given in the table below:

TABLE 4.—*Amount of paraffin retained by cheese after immersion.*

Temperature of paraffin.	Time dipped.	Weight of each lot of cheese—		Paraffin retained by cheese.
		Before dipping.	After dipping.	
°F.	*Seconds.*	*Pounds.*	*Pounds.*	*Pounds.*
190	1	168.81	169.94	1.13
	5	168.94	170.00	1.06
	30	168.50	169.33	.83
240	1	169.25	170.16	.91
	10	167.91	168.56	.65
275	1	168.06	168.78	.72
	10	168.72	169.22	.50

The table shows that there is considerable variation in the amount of paraffin adhering to the surface of the cheese when dipped at different temperatures and for different periods. However, the total amount retained by any one lot is very small compared with the weight of the cheese paraffined; and when it is considered that the total surface of the cheese in each lot was about 25 square feet, it can be seen that the paraffin coat is very thin. Though paraffin costs

much less per pound than cheese, it is only in exceptional cases that any attempt is made to give the cheese a heavier coat than is necessary to protect it.

SUMMARY.

1. Paraffining is an effective method (1) of preventing losses in weight of cheese due to evaporation, and (2) of preventing the growth of mold.

2. All temperatures of the melted paraffin of 220° F. and above are satisfactory for doing this work, and the experiments showed that the length of time (from 1 to 10 seconds) the cheese was immersed at these temperatures was immaterial.

3. A temperature of 190° F. secured in a hot-water-bath outfit was not satisfactory, but where it is used the cheese should be immersed for at least 5 seconds.

4. Paraffining at three days from the press gave the best results.

5. The amount of paraffin adhering to the cheese varied with different temperatures of the paraffin and the length of time the cheese was immersed.

6. Cheese should not be allowed to remain in a warm curing room for more than one day after paraffini

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